the dry and wet bulb hygrometer will, from its great simplicity and on the whole very satisfactory working, continue to be the most suitable instrument to put into the hands of ordinary observers for observations of the humidity of the atmosphere; and since the dew-point, elastic force of vapour, and humidity are not directly observed by this instrument, but are only deductions from the observations, it is most desirable that the methods of reducing the observations be the best attainable. The tables at present in use, while tolerably good for the temperatures ordinarily observed in this country, are very inaccurate for times of great drought and heat. Indeed it is essential to the development of this important branch of meteorology that the tables for the reduction of the hygrometric observations be submitted to a thorough revision, since reductions by different methods now in use give in extreme cases, from observations of the same air, dew-points differing fully 20°·0 from each other. Extensive experiments and observations are also required in order to ascertain the conditions of a good position for the anemometer, to devise some means for comparing velocity anemometers, and to determine the relation of the velocity of the wind to the pressure which it exerts. These important practical questions, of which we are at present altogether ignorant, can only be adequately investigated at an observatory devoted to researches in physical meteorology.

In order to complete the preliminary meteorological survey of the earth's atmosphere and surface it is indispensable that measures be taken to obtain observations from the less frequented regions of the ocean, from Arctic and Antarctic regions, large portions of British America, South America, Africa, and Polynesia; as well as observations of underground temperature obtained by improved methods at greater depths and from a more extended area of the earth's surface than have hitherto been made; and observations of the temperature of lakes at the surface, at great depths, and at their outflow. Till this be done our knowledge of terrestrial physics must be very imperfect. The extent of the British dependencies, the regions into which British commerce penetrates, and the readiness British " exiles " show to forward meteorological inquiries, point out that it is mainly to Great Britain we are to look to fill up the present blanks in the meteorology of the globe.

In working out the great national question of *local climates* it is absolutely indispensable that uniformity as regards instruments and methods of observation be secured at the different stations. This many-sided problem admits of different methods of treatment according as the inquiry is directed to agriculture, commerce, public health, or any of those other interests or pursuits which are more or less influenced by weather and climate. In investigating local climate in these relations new lines of inquiry must be set on foot. The nature and importance of some of these inquiries may be illustrated by referring to two lines of research recently taken up by the Scottish Meteorological Society, and noticed in NATURE at the time. It is proposed to inquire into the influence of the sea on climate, particularly the extension inland of this influence, which has so marked an effect on animal and vegetable life and such important bearings on the national prosperity, by establishing strings of stations from different points on the coast, and extending from the sea-shore to about two miles inland. It is further proposed to investigate certain of the more important practical problems—such as the relation of wind-force to the barometric gradient—by thickly planted *storm-stations*, radiating in lines in various directions from Edinburgh.

If meteorology is to be built on the solid ground of rigorously attested facts, it is imperative that measures be taken for the prosecution of such lines of investigation as those now indicated. To those who have given any consideration to the matter it is unnecessary to add that in no other way can the meteorology of the British Isles be placed on a thoroughly sound and satisfactory footing.

With reference to the means by which these physical and climatic researches in meteorology are to be carried on, it may be suggested whether, considering the local influence and knowledge which are absolutely essential for the successful prosecution of inquiries into local climates, it would not be the best as well as most economical course for the Government to avail itself of the assistance of the Meteorological Societies. On the other hand, the physical researches we have indicated, together with storm warnings, ocean meteorology, and some other departments of climatic meteorology beyond the power of Societies, can only be undertaken by the Government. In the future development of the meteorology of the British Isles, the co-operation of the Meteorological Societies with the Central Department is necessary, each having its own separate sphere of action, and each being to a large extent dependent on the other.

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## RECENT FRENCH GEOLOGICAL WORKS

*Principes de Géologie Transformiste.* Par Gustave Dolfuss. (Paris, Savoy, 1874.)

*Eléments de Géologie et de Paléontologie.* Par Ch. Contjean. (Paris, Baillière et Fils.)

THESE two recent French publications connected with Geology we propose to notice briefly together. In M. Dolfuss's earnest and suggestive little book another proof is given of the way in which the views of the Evolution School are permeating the minds of the rising generation of students in every branch of Science. If we may judge of the author from a perusal of his work, he is an enthusiastic palæontologist, who, drinking at the fountains of Darwinism, seeing clearly enough the tendency of modern thought, and full of dreams about the great future of his favourite science, has with the eagerness of a neophyte rushed forward to preach the creed which he so firmly believes. Whether or not this surmise be a true one, the book has much of the earnestness, ambition, vagueness, and inexperience of an early literary venture of an aspirant to fame. The real downright earnestness of the writer is one of the best features of the book. But we imagine that this quality would not have been impaired by a little delay in publication. The historical summary shows how limited is the author's range of reading. He speaks, for example, of Hutton having attributed everything in geology to the action of fire—an utter misconception and misstatement of the doctrines of the great philosopher.

He very properly claims for Constant Prevost a high place in the list of writers by whom modern geology has been mainly influenced. Indeed the great merits of that far-seeing man are not properly understood and acknowledged even in his own country; they are almost unknown among ourselves. At the same time it is a great mistake to attribute to him, as M. Dolfuss does, the founding of the school whose leading principle is "the present the key to the past." Again Lyell's *Principles* are spoken of as having appeared in the same year (1827) with Prevost's early speculations. But the first volume of the first edition of Lyell's work was not published until 1830. While acknowledging the value of the English geologist's writings, M. Dolfuss passes a rather severe, and we think not wholly justifiable, criticism upon their style, going even so far as to say that it needs real courage to follow the author of the "Principles of Geology" through his weary digressions and diffuse detail of facts. In short, M. Dolfuss looks at the historical development of geological thought through a French pair of spectacles. And in his account of the present condition of geology, the doings of his friends in France bulk as largely as those of all the rest of the world put together. This is a very innocent vanity, especially as it is coupled with profound respect for, though inadequate knowledge of, the "opinions contemporaines à l'étranger." But it evidently deprives its author's summary of the weight which a broad and impartial review would have had.

As regards M. Dolfuss's facts, he certainly does not trouble us with any measure of that wearisome detail which he deplores in some English writers. Indeed, his references to the geological formations are so sketchy, that great portions of them might have been as well omitted. Greater development might have then been given to those whence the author can cite the largest body of evidence in favour of his views. It would have been still better, however, had he been aware of the researches made in other countries, notably in Britain, regarding the physical geography of former geological periods. He could then have filled up a good many blanks in his narrative, particularly as regards the older formations. He dwells on the artificiality of the subdivisions of the geological record, the necessity for constantly judging of their value by reference to analogous cases in operation at the present time, the value of a species in stratigraphy and in palæontology. Much of what he has to say on these subjects has long been familiar to working geologists in this country, and they will be pleased to see these sound notions gaining ground abroad, and displacing the systematic "cut and dry" measuring-rod style of subdivision and classification which looks so pretty in the pages of D'Orbigny, but which has no counterpart in nature. As a curious illustration of the want of wide reading we may notice that while discussing the nature and value of species as landmarks in the geological record the author seems unaware of Ramsay's important observations on "breaks in succession" among organic remains. We earnestly recommend him not to confine his studies to such foreign memoirs as may chance to find themselves honoured by translation into the *Revue des Cours Scientifiques*, but to seek out the original sources and learn what a vast amount of sound geological work bearing on the subject he has at heart has been accomplished in recent years outside of France, in which French geologists have taken no share, and of which it is to be suspected they remain to a large extent in wilful and perhaps happy ignorance.

Prof. Contjean's "Eléments de Géologie" is a singularly excellent work; in scope it travels over a vast range of subjects—astronomy, physical geography, meteorology, mineralogy, and other branches of Science, besides the two which specially appear on the title-page. So far as we have examined it, the book is careful, exact, and full. Prof. Contjean takes his readers first through planetary space, and having given them some notion of what it is he brings them down to Mother Earth, and proceeds to dissect her with great cleverness. At the outset he states the phenomena connected with the position of our globe as a planet, and then leads us through the physical characters of the surrounding atmosphere, the seas, and the solid crust, with its overlying plains, valleys, and mountains. Having in this way described the parts of the earth he proceeds to give a most clear and satisfactory account of the phenomena of which the earth is at present the theatre—those of the air, of water, whether solid, as snow and ice, or liquid, as rain, streams, and lakes; of the solid land, such as earthquakes and volcanoes; and, lastly, of the organic influences at work in producing changes on the earth's surface. On this solid foundation of knowledge as to what our globe is at the present time the author in the last part of his book builds his narrative of what that globe has been in past ages. He now gives a succinct and rather meagre account of rocks and minerals, followed up by a much better disquisition on sedimentation (a word, by the way which we might advantageously introduce into our English geological vocabulary). His paragraphs devoted to geological structure—faults, joints, cleavage, &c.—furnish a fresh example of how little the value of these parts of practical geology is understood abroad. What we ordinarily term stratigraphical or historical geology, that is the history of the various geological formations, occupies relatively but a small part of the book. It ought to have been fuller. The various formations for the sake of convenience might have been more sharply and clearly distinguished from each other in the printing. Above all information should have been given regarding the nature, succession, and geographical distribution of the several rocks or formations from which the story of the geological record is compiled. The palæontological *résumé* under each formation is good as far as it goes, and is well illustrated with good figures. Throughout the volume the illustrations are much above the average and have likewise the great redeeming feature of not being merely repetitions of the same old drawings which have done duty in text-books in almost every language under the sun for the last twenty or thirty years.

Prof. Contjean has produced a book which is likely to be in the highest degree useful to his countrymen. He not only gives a clear and intelligible digest of what is known regarding the several subjects on which he treats, but intersperses here and there original discussions of his own, which are full of interest, and give us a very favourable impression of his powers, both as a thinker and writer. We would especially cite his examination of M. Elie de Beaumont's theory of the elevation of mountain chains. In this country, where the theory of that distinguished French *savan* has never had any hold, it may seem superfluous now-a-days to take up time in the disproof of it. But those who know what a power Elie de Beaumont has been and still is in France, how with all his abilities and knowledge and the excellent service which he has rendered by his map and other publications, he has for many years been a kind of dark shadow on the progress of the newer geology in his country, will thank the Professor at Poitiers for taking such pains to demolish the *réseau pentagonal.*

## *OUR BOOK SHELF*

*Handbook of Natural Philosophy.* By Dionysius Lardner, formerly Professor of Natural Philosophy and Astronomy in University College, London. "Hydrostatics and Pneumatics." New Edition, edited, and the greater part rewritten by Benjamin Loewy, F.R.A.S. (London: Lockwood and Co., 1874.)

DR. LARDNER'S treatise on Natural Philosophy is quite familiar to those who studied Science ten or fifteen years ago. Before Ganot and Privat-Deschanel were translated, Lardner was *the* book which everyone used. It was originally almost a translation of Pouillet's "Eléments de Physique," but was added to from time to time, and is still a valuable text-book, especially the new editions of it edited by Prof. G. C. Foster, and (as in the present instance) by Mr. Benjamin Loewy. The value of the book is indeed shown by the fact, that although first published many years ago, it is still deemed worthy of new editions, and of being edited by well-known men. The volume before us has been carefully edited, augmented to nearly twice the bulk of the former edition, and all the most recent matter has been added. The treatment is essentially experimental and elementary; a slight knowledge of mathematics is needful. It is to be regretted that Mr. Loewy has not introduced metrical weights and measures. A few omissions may be noticed: the *action latérale* of Venturi is scarcely alluded to; the theory of the trompe is omitted, as are also the hydrodynamic experiments of Plateau and Magnus, and the account of Dr. Guthrie's experiments on approach caused by vibration. But the book has in the main been carefully edited and improved.

*Les explorations Sous-Marines.* Par Jules Girard. (Paris: Libraire, F. Savy, 1874. London: Dulau and Co.)

NO nation surpasses the French in brilliant popular expositions of the various departments of Science. They already possess a large number of works of this kind, several of which have been translated into English, and the present work by M. Girard deserves to take its place among them as an extremely interesting and wonderfully full account of the numerous and valuable results which have of late years been obtained by deep-sea exploration. The two introductory chapters gives a rapid *résumé* of the history of deep-sea exploration, with a short description of the interior economy of the *Challenger*, and a clear and pretty full description of the various apparatus used in carrying on the explorations. The subsequent part of the work consists of four divisions, the first of which treats of the characteristics of the sea-bottom looked at in its geographical relations; the second treats of life in the depths of the sea, describing eloquently the various organisms which inhabit the ocean; the third division deals with the waters themselves, pointing out the chemical properties and the physical phenomena which take place in the midst of the ocean; in the last division an attempt is made to depict the seas of ancient geological epochs, and compare them with the discoveries which have been made by recent soundings. The author seems to have fairly mastered the literature of his subject, and has managed to write a book containing a vast deal of information conveyed in clear and eloquent language. The work is profusely illustrated with artistically executed, useful, and most attractive woodcuts. The work might well be translated into English.

## *LETTERS TO THE EDITOR*

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

### The Habits of various Insects

[The following letter on this subject, from Fritz Müller to Mr. Charles Darwin, F.R.S., has been forwarded to us for publication by the latter.—ED.]

I DELAYED answering your kind letter of January 1 till I should have had an opportunity of examining once more some nests of leaf-cutting ants, to which you had directed my attention. In the meantime I received Belt's "Nicaragua," which I have read with extraordinary interest, and for which I must express to you my hearty thanks.

I was much surprised to learn from Mr. Belt's book how closely the far-distant province of Chontales resembles by its vegetation and animal life our own of Sta. Catharina. I am thus enabled fully to appreciate the exactness of many of his statements; he is an excellent observer, and most of his theories are very seducing. As to leaf-cutting ants, I have always held the same view which is proposed by Mr. Belt, viz. that they feed upon the fungus growing on the leaves, they carry into their nests, though I had not yet examined their stomachs. Now I find that the contents of the stomach are colourless, showing under the microscope some minute globules, probably the spores of the fungus. I could find no trace of vegetable tissue which might have been derived from the leaves they gather; and this, I think, confirms Mr. Belt's hypothesis. Here, as in Nicaragua, the Cecropiæ are always inhabited by ants, but, I think, by only a single species. I have cut down hundreds of them and never missed the ants. I wonder that it had never occurred to me that the trees are protected by the ants; but there can be no doubt that this is really the case, for young plants of Cecropiæ, not yet inhabited by ants, are often attacked by herbivorous insects.

A few days ago I caught on the flower of a Vernonia a female moth belonging to the Glaucopidæ, of which family there are here numerous species. When I seized it by the wings nearly the whole body became suddenly enveloped in a large cloud of snow-white wool, which came out of a sort of pouch on the ventral side of the abdomen, and consisted of very thin flexuous hairs 1—2 mm. long, three, four, or five of which used to proceed from the same point. I preserved the moth alive for some time, and as often as I seized her by the wings, by inflating the abdomen, a large naked membrane became visible, and somewhat protruded behind the first (white) segment of the ventral face of the abdomen (the rest of which is black), and a little more wool appeared under the posterior margin of this segment. I am at a loss as to the meaning of this curious contrivance. There is in the males of the same family an interesting secondary sexual character; they are able to protrude from near the end of the abdomen a pair of long hollow hairy retractile filaments, which in some species exceed the whole body in length. In the beautiful *Belemnia inaurata* there is a second pair of shorter filaments which are wanting in all the other species I examined (*Eunomia eagrus*, *Euchromia jucunda*, *Agyrta cœrulea*, *Eudule invaria*, *Leucopsumis* sp., *Philoros* sp., &c., the names of which I owe to the kindness of Dr. A. Gerstäcker, of Berlin). In some species, most distinctly in *Belemnia inaurata*, I perceived a peculiar odour when the filaments were protruded; this, I think, may serve to allure the females, which in all our species appear to be much less numerous than the males.

I mentioned to you that with our stingless honey-bees wax is secreted on the dorsal side of the abdomen; now this is also the case with some of our solitary bees, for instance, *Anthophora fulvifrons* Sm., and with some species nearly allied to that genus. These solitary bees probably use the wax only to cement the materials with which they build their nests. Our species of Melipona and Trigona also never employ pure wax in the construction of their cells or of the large pots wherein they guard their provisions; they mix it with clay, resinous substances, &c., so that in some species wax forms hardly 10 per cent. of the material. The only case, as far as I know, in which pure wax is